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ANALYSIS OF THE EFFECT OF ADDITION OF INJECTION PLASTIC SEEDS (HDPE), QUARTZ SAND AND ADDITIVE TO CONCRETE MIXTURE

Tjatur Rahmadi Maulana[1], Fredy Kurniawan[2].
University of Narotama, Surabaya
tjaturrahmadi@gmail.com

ABSTRACT

Plastic material is one of many materials that are difficult to decompose naturally and require hundreds of years to decompose completely. One way to reduce the volume of plastic waste is to process or recycle it. Plastic injection seeds (HDPE) is one type of processed plastic waste (HDPE). In this study using the concrete laboratory experimental method according to SNI 03-2834-2000. There are 2 stages in this concrete research, stage 1 is concrete with variations of quartz sand (20%, 30%, and 40%) to the weight of sand and the most optimum results are obtained in concrete mix with 40% quartz sand and 3% additive (TH1 / 40-28) which is equal to 613.1 kg / cm2 in the 28 day test, an increase of 42.34% from the compressive strength of normal concrete K300 of 430.73 kg / cm2. For phase 2, concrete with a variation of quartz sand is 40% and the addition of coarse aggregates from plastic seeds (HDPE) (20%, 30% and 40%) from the weight of gravel and find the most optimal results of concrete mix with 40% quartz, plastic 20% , additive 3% (TH2 / 20-28) which is equivalent to 359.5 kg / cm2 in a 28 day test, a decrease of 41.4% from the compressive strength of concrete stage 1 quartz sand 40% (TH1 / 40-28) from 613, 1 kg / cm2.

Key words: *hdpe plastic seeds; quartz sand; additive; compressive strength; concrete.*

INTRODUCTION

Developments in the construction sector are currently progressing very rapidly. This is inseparable from the demands and needs of the community for increasingly advanced infrastructure, such as bridges with long spans, tall buildings and other facilities. Concrete is one of the choices as a basic structural material in building construction. In general, concrete consists of cement, fine aggregates, coarse aggregates and water. But along with the development of science and technology, the composition of the concrete mixture also changed.

One example is the inclusion of added ingredients or substitutes in concrete. Utilization of plastic waste for concrete mixtures is one step to reduce plastic waste problems that until now have not been overcome. Plastic waste has several advantages, namely having a light weight, not easy to change shape, and also has a weakness that is

having a slippery surface and very difficult to decompose by nature, this often leads to environmental pollution.

From such problems arises a thought for the research of mixing concrete using artificial aggregates from waste plastic (HDPE) with, quartz sand and additive materials. The purpose of this study was to determine the behavior of the value of compressive strength of concrete with a mixture of artificial aggregate from plastic waste (HDPE) as a partial substitute for the total gross weight of the aggregate. The results of this study are very useful as one of the references for the manufacture of lightweight concrete materials using mixed waste materials so that they can be utilized in infrastructure development such as buildings and others.

RESEARCH METHODS

A. Material

The materials to be used in this study include:
Portland cement Type 1 (PCC) Brand: Semen Gresik, Natural Sand (Lumajang), Quartz Sand, Rough Aggregates Type: Broken Stone (Split), Water, HDPE Injection Plastic Seeds Size: 4x2 mm (flat oval), Additive Additon Superplast 23F Size: 0.4-2% of the weight of cement

B. Standard Operating Procedure

1. Prepare split aggregates, sand, and cement according to the job mix then mix evenly.
2. Add half a dose of water (F.A.S 0.3-0.35% of the weight of the cement and stir until smooth).
3. Pour the measured Additon Superplast liquid (0.4 - 3% Additon Superplast from the weight of the cement to mix the concrete 1 m³) gradually while stirring evenly, finally add the remaining water until the mixture becomes homogeneous (slightly dry).
4. Concrete is ready for use.
5. Important: Do not add Additon Superplast directly to the cement.

Tabel 1. Mixed Design Formula

Description	Cement		Sand Lumajang		Sand Quartz		Gravel		Plastik		Air		Additif Additon Superplast 23F	
											Water Cement 0,3		**3% from weight of cement**	
Normal Concrete k 300	566,7	kg	1.149,0	kg	-	kg	766,0	kg	-	kg	170,0	L	17,0	L
TH1/20	566,7	kg	919,2	kg	229,8	kg	766,0	kg	-	kg	170,0	L	17,0	L
TH1/30	566,7	kg	804,3	kg	344,7	kg	766,0	kg	-	kg	170,0	L	17,0	L
TH1/40	566,7	kg	689,4	kg	459,6	kg	766,0	kg	-	kg	170,0	L	17,0	L
TH2/20	566,7	kg	689,4	kg	459,6	kg	612,8	kg	153,2	kg	170,0	L	17,0	L
TH2/30	566,7	kg	689,4	kg	459,6	kg	536,2	kg	229,8	kg	170,0	L	17,0	L
TH2/40	566,7	kg	689,4	kg	459,6	kg	459,6	kg	306,4	kg	170,0	L	17,0	L

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Table 2. Total Test Objects

Test Object Samples	Concrete Age		
	7 days	14 days	28 days
Normal Concrete k 300	2	2	2
TH1/20	2	2	2
TH1/30	2	2	2
TH1/40	2	2	2
TH2/20	2	2	2
TH2/30	2	2	2
TH2/40	2	2	2
Total	14	14	14
Total cylindrical mold test specimens: 15 Height: 30 cm, 42 pieces used.			

After the fresh concrete reaches homogeneous, slump testing is carried out. At the stage of maintenance of the test object, carried out after a day's age by immersing the test object in the curing tub for 7 days.

Compressive strength testing was carried out on specimens aged 7, 14 and 28 days, after the drying process from the treatment of specimens. Compressive strength testing was carried out in the Civil Engineering and concrete laboratory of Narotama University Surabaya.

RESULTS AND DISCUSSION

Fine and coarse aggregate testing includes humidity, specific gravity, volume weight, cleanliness, sieving, as follows:

A. Analysis of Lumajang Sand and Quartz Sand

Table 3. Testing of Fine Aggregates

No.	Testing	Unit	Fine aggregate	
			Sand Lumajang	Sand Quartz
1	Sludge levels			
	a. Sedimentation	%	0,01	0,01
	b. Washing	%	5,74	0,43
2	SSD Specific Gravity	gr/cm3	2,25	2,75
3	Moisture Sand	%	8,18	0,90
4	Absorption	%	1,24	1,21
5	Volume Weight			
	a. Without pressure	gr/cm3	1,23	1,32
	b. With pressure	gr/cm3	1,71	1,68
	c. With sway	gr/cm3	1,26	1,46

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B. Gravel Analysis

Table 4. Testing of Rough Aggregates

No.	Testing	Unit	Rough Aggregate
			Gravel
1	Sludge levels		
	a. Washing	%	2,20
2	SSD Specific Gravity	gr/cm3	2,41
3	Moisture Stone	%	2,78
4	Absorption	%	5,49
5	Volume Weight		
	a. Without pressure	gr/cm3	1,40
	b. With pressure	gr/cm3	1,54

C. Aggregate Analysis of HDPE Injection Plastic Seeds

Has a flat round shape with dimensions of 4 x 2 mm, slippery plastic surface.

Picture 1: Aggregate of HDPE Injection Plastic Seeds

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D. Results and Comparison of Concrete Press Strength

Table 5 Results of Testing Phase 1 Concrete Compressive Strength Stage 1 (Concrete Aggregate Mixture of Quartz Sand 20%, 30%, 40% and Additive Superplast Add 3%).

No	Concrete type	KN	MPA	Concrete Press Strength (kg/cm2)	Specific gravity (kg/m3)
1	Normal Concrete K300 - 7 days	407,5	23,1	283,1	2.296,9
2	Normal Concrete K300 - 14 days	547,5	31,0	380,4	2.292,8
3	Normal Concrete K300 - 28 days	620,0	35,1	430,7	2.315,5
1	Concrete Stage 1, Quartz Sand 20% TH1/20 - 7 days	392,5	22,2	272,7	2.243,8
2	Concrete Stage 1, Quartz Sand 20% TH1/20 - 14 days	590,0	33,4	409,9	2.242,8
3	Concrete Stage 1, Quartz Sand 20% TH1/20 - 28 days	662,5	37,5	460,3	2.317,5
1	Concrete Stage 1, Quartz Sand 30% TH1/30 - 7 days	515,0	29,1	357,8	2.246,4
2	Concrete Stage 1, Quartz Sand 30% TH1/30 - 14 days	690,0	39,0	479,4	2.245,0
3	Concrete Stage 1, Quartz Sand 30% TH1/30 - 28 days	777,5	44,0	540,2	2.303,1
1	Concrete Stage 1, Quartz Sand 40% TH1/40 - 7 days	732,5	41,4	508,9	2.247,9
2	Concrete Stage 1, Quartz Sand 40% TH1/40 - 14 days	822,5	46,5	571,4	2.317,5
3	Concrete Stage 1, Quartz Sand 40% TH1/40 - 28 days	882,5	49,9	613,1	2.284,3

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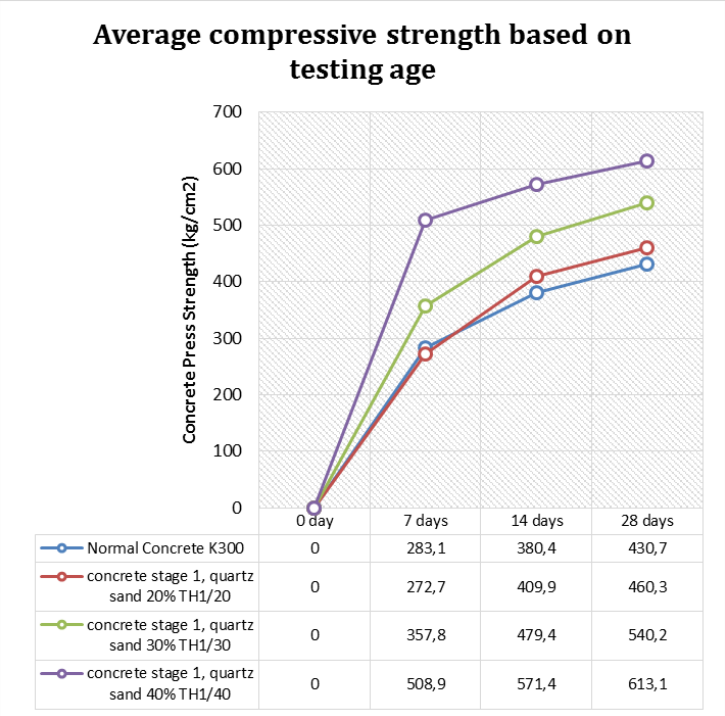

Chart 1 Shows the Increased Press Strength of the Combined Concrete Between Normal Concrete With Concrete Stage 1, Based on Testing Age 7, 14, 28 Days.

From Graph 1 above shows the compressive strength of normal K300 concrete with stage 1 concrete (TH1) with a mixture of quartz sand 20%, 30%, and 40%. At the time of testing, the largest value of compressive strength of concrete was found in the stage 1 concrete mixture with quartz sand 40% and Additive Superplast 23F 3% from the weight of cement (TH1 / 40-28) which is equal to 613.1 kg / cm2 at 28 days testing , there was an increase of 42.34% from the normal concrete compressive strength of K300 of 430.73 kg / cm2.

This proves that there is an increase in the strength of concrete along with the increasing composition of the mixture of quartz sand (20%, 30%, and 40%) even though the levels of cement and additives are the same.

It can be concluded that the design of normal K300 concrete mixtures and concrete using quartz sand with additive mixture of Additon Superplast 23F does not have a significant impact on mass weight and specific gravity.

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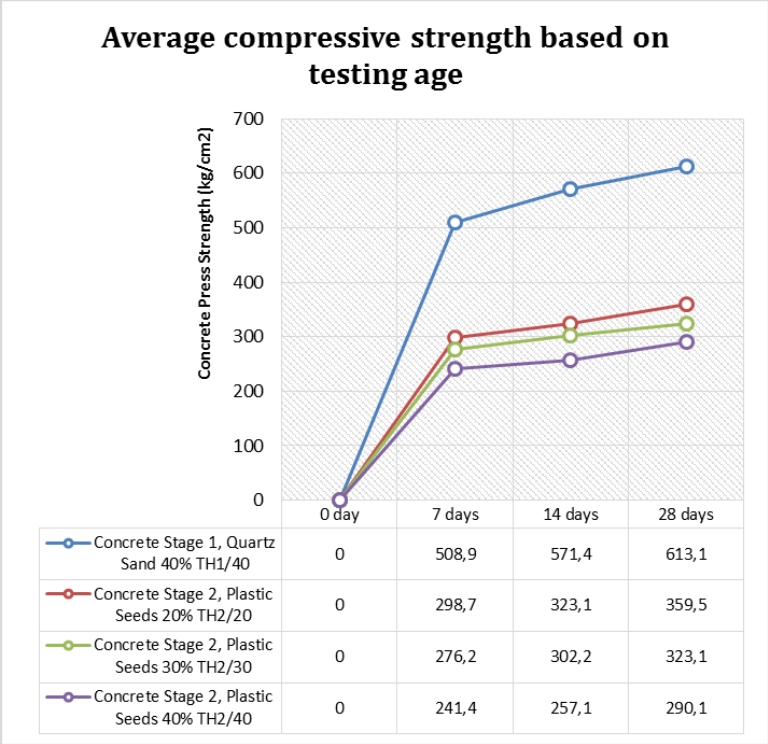
Table 6 Results of Phase 2 Concrete Compressive Strength Test Stage 2 (Aggregate Concrete Mixture 40% Quartz Sand, HDPE Plastic 20%, 30%, 40%, and Superplast Additives 3%)

No	Concrete type	KN	MPA	Concrete Press Strength (kg/cm2)	Specific gravity (kg/m3)
1	Concrete Stage 1, Quartz Sand 40% TH1/40 - 7 days	732,5	41,4	508,9	2.247,9
2	Concrete Stage 1, Quartz Sand 40% TH1/40 - 14 days	822,5	46,5	571,4	2.317,5
3	Concrete Stage 1, Quartz Sand 40% TH1/40 - 28 days	882,5	49,9	613,1	2.284,3
1	Concrete Stage 2, Plastic Seeds 20% TH2/20 - 7 days	430,0	24,3	298,7	2.070,2
2	Concrete Stage 2, Plastic Seeds 20% TH2/20 - 14 days	465,0	26,3	323,1	2.079,5
3	Concrete Stage 2, Plastic Seeds 20% TH2/20 - 28 days	517,5	29,3	359,5	2.075,6
1	Concrete Stage 2, Plastic Seeds 30% TH2/30 - 7 days	397,5	22,5	276,2	2.001,6
2	Concrete Stage 2, Plastic Seeds 30% TH2/30 - 14 days	435,0	24,6	302,2	2.004,0
3	Concrete Stage 2, Plastic Seeds 30% TH2/30 - 28 days	465,0	26,3	323,1	1.991,4
1	Concrete Stage 2, Plastic Seeds 40% TH2/40 - 7 days	347,5	19,7	241,4	1.954,9
2	Concrete Stage 2, Plastic Seeds 40% TH2/40 - 14 days	370,0	20,9	257,1	1.956,0
3	Concrete Stage 2, Plastic Seeds 40% TH2/40 - 28 days	417,5	23,6	290,1	1.957,2

Chart 2 Shows the Increased Press Strength of the Combined Concrete Between Concrete Stage 1 (40% Quartz Variation) With Stage 2 Concrete (Plastic Variation) Based on Testing Age 7, 14, 28 Days



	0 day	7 days	14 days	28 days
Concrete Stage 1, Quartz Sand 40% TH1/40	0	508,9	571,4	613,1
Concrete Stage 2, Plastic Seeds 20% TH2/20	0	298,7	323,1	359,5
Concrete Stage 2, Plastic Seeds 30% TH2/30	0	276,2	302,2	323,1
Concrete Stage 2, Plastic Seeds 40% TH2/40	0	241,4	257,1	290,1

From Graph 2 above shows the compressive strength of concrete stage 1 quartz sand 40% (TH1 / 40) with concrete stage 2 (TH2) mixed 20%, 30%, and 40%. At the time of testing, the value of the largest concrete compressive strength was found in concrete mixtures with 40% quartz sand, 20% plastic aggregate, and 23F Superplast Additives of 3% by weight of cement (TH2 / 20-28) which is 359.5 kg / cm2 in the test 28 days, there was a 41.4% decrease in stage 1 concrete compressive strength of quartz sand 40% (TH1 / 40-28) of 613.1 kg / cm2.

This proves that there is a decrease in the strength of concrete along with the increasing composition of the mixture of HDPE plastic aggregates (20%, 30%, and 40%) even though the levels of cement, sand and additives are the same. There is a decrease in mass and specific gravity weight as the composition of the mixture of HDPE plastic aggregates increases (20%, 30%, and 40%) despite the same levels of cement, sand and additives.

CONCLUSION

Based on the results of research and discussion, conclusions can be taken as follows:

1. In the mixed design stage 1, the optimum concrete compressive strength was achieved in a mixture of 40% quartz sand from the weight of sand, and 23pl Superplast 3% of the weight of cement (TH1 / 40-28) which was 49.9 MPa using a cylindrical specimen Ø 15 cm x 30 cm with a drop value of 4 cm. So the mixed design (TH1 / 40) is used as the basis for the mixed design stage 2.
2. In the mixed design stage 1 optimal concrete compressive strength values were achieved in a mixture of 40% quartz sand from sand weight, 20% HDPE plastic from gravel weight, and 23F 3% Superplast additives from cement weight (TH2 / 20-28) which is 29,3 MPa with slump 4 cm. So that it can be categorized as high quality concrete K300 (29.4 MPa).
3. The use of additives added by the Additon Superplast 23F brand must use the ideal amount of water, because if too much water will occur blending and segregation. Concrete dough like pasta, concrete mixture quickly hardens so that the concrete mixing work is heavier.

SUGGESTION

From the description above and referring to the results of the study, to get better research results, the following are suggested by researchers:

1. For similar studies, it is necessary to change HDPE plastic aggregate using artificial plastic or aggregates which are melted and crushed, because researchers have used HDPE plastic seed aggregates that are flat round and have dimensions of 4 x 2 mm.
2. For the use of HDPE plastic seed aggregates as lightweight walls it is not recommended, because if the concrete is damaged or perforated there will be a concrete collapse which results in severe damage to the concrete..

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